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Selective Intra-Arterial Digital Subtraction Angiography (IADSA) in Cerebrovascular Disease: Preliminary Report of Right Transbrachial Approach

Akira Uchino, Yoshiyuki Satoh and Masato Ohno
Department of Radiology, Kyushu Rosai Hospital

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脳血管病変における右上腕動脈経由の選択的動注DSAの初期経験

九州労災病院放射線科
内野　晃　佐藤　兆志　大野　正人

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4Fモディファイド・シモンズ型カテーテルを用いて，右上腕動脈経由の選択的動注DSAを，脳血管病変を有するかまたは疑われる26例（うち外来4例）に試みて24例に成功した．失敗した2例はいずれも高齢の高血圧を有する男性で，上腕動脈の著明な屈曲によった．また，1例ではaberrant right subclavian arteryであったため，両側総頚動脈の造影はできなかった．合併症は経験しなかった．両側総頚・右椎骨動脈の造影は2倍希釈して37℃に温めた造影剤10mlを5ml/sの速度で注入した．118回の造影のうち110回にexcellentな画像が得られた．検査時間は上記3本の動脈造影で，平均29.4分であった．

よって，本法は脳血管病変の診断において安全かつ有用で，比較的容易な検査法であると結論した．

Abstract

Selective right transbrachial intra-arterial digital subtraction angiography (transbrachial selective IADSA) was successfully performed for 24 of 26 patients with known or suspected cerebrovascular disease, four of whom were outpatients. Catheterization failed in two elderly hypertensive men because of tortuosity of their brachial arteries, and in one woman whose aberrant right subclavian artery (SCA) prevented bilateral common carotid arterial (CCA) catheterizations. No complications occurred. One-hundred and ten "excellent" images were obtained by means of 118 injections for the 24 patients. Iopamidol, the contrast medium, was diluted to 50% concentration with saline, then warmed to 37°C. Nearly all the injections of both CCAs and right vertebral arteries (VAs) were completed using 10 ml injections and a 5 ml/sec flow rate. The mean examination time for the three-vessel study was 29.4 minutes.

Transbrachial selective IADSA thus proved to be a safe, useful, and relatively easy means of diagnosing cerebrovascular disease.

Introduction

According to several reports, intra-arterial digital subtraction angiography (IADSA) via transbrachial arch injections is practical and safe[1)-4)], though its images are not as "excellent" as those of selective IADSA via the transfemoral approach[5)]. This is a preliminary report of transbrachial selective IADSA for cerebrovascular disease using a 4-F modified Simmons type nylon catheter[6)].

Materials and Methods

From December 1986 through March 1987, 26 patients with known or suspected cerebrovascular disease underwent transbrachial selective IADSA. Four of the 26 were outpatients. There were 19 men and seven women whose ages ranged from 33—71 years and averaged 55.7 (Table 1).

Minor tranquilizer (Hydroxyzine HCl) and anticholinergic agent (Atropine sulfate) were routinely used for premedication. All studies were performed with an 80 cm long 4-F modified Simmons type nylon catheter (Mallinkrodt) which accepts a 0.032-inch diameter guide wire. Due to the C-arm type DSA unit, a 'right' brachial artery approach was used for all cases. Arterial punctures were performed at the antecubital fossa, using a 19 gauge needle. The catheter tip was positioned in one or more of the following

Table 1 Cases investigated, by diagnosis

Diagnoses	Cases
Cerebral infarction	14*(1)
Postoperative state	4(1)
Cerebral aneurysm (suspected)	3(1)
Vascular malformation (suspected)	2(1)
Vertebrobasilar insufficiency	1
Transient ischemic attack	1
Asymptomatic bruit	1
Total	26(4)

( )…Outpatient

*……Two of this patient's catherizations were unsuccessful.

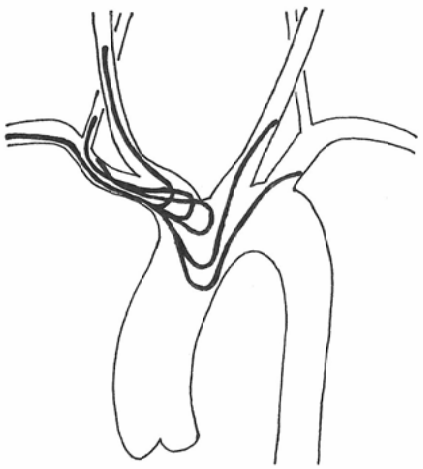

Fig. 1 Schematic illustration of catheter tip locations.

vessels; the right CCA, the left CCA, the right VA, the left SCA, the right SCA, and the left VA (direct origin) (Fig. 1).

For all patients Iopamidol (Iopamiron 300, Schering) was used. The contrast medium, was diluted to 50% concentration with saline, then warmed to 37°C using a Ready-Box (Mallinckrodt). Nearly all injections of both CCAs and the right VA were performed using a Mark IV (Medrad) injector, by which 10 ml each was injected at a 0.2 sec linear rise, and a 5 ml/sec flow rate.

All studies were performed using a Toshiba DFP-03A apparatus, having a 512 × 512 matrix and an image intensifier (I.I.) of 7, 10, and 14 inches. Normally, the internal carotid artery courses posterolaterally to the external carotid artery. Therefore, from the carotid bifurcation to the level of the base of the skull of the right and left internal carotid arteries were examined with 60° left and right posterior oblique projections using a 10 inch I.I.. The intracranial portions and branches of both internal carotid arteries were examined with posteroanterior (PA) projections using a 10 inch I.I.. When necessary, lateral and/or additional projections at special angle were obtained. The intracranial portion of the vertebrobasilar system was routinely examined using a 7 inch I.I. at straight PA projection.

After catheter removal, finger pressure was applied to the puncture site for 10 minutes. Inpatients were taken to the ward immediately, and orders were given to the nurse to check the pulse deficit and hematoma periodically for three hours. Outpatients were observed in the radiology department for three hours. An arm board was used to immobilize the right elbow in a slightly bent position throughout this

Table 2 Results of transbrachial selective IADSA (24cases)

Catheter tip location	Projection	Injection volume (ml)	Flow rate (ml/sec)	Injections number	Resulting images		
					E	G	P
RCCA	LPO 60°	10	5	17	17		
	PA	10	5	20	20		
	Others			4	4		
LCCA	RPO 60°	10	5	18	17	1	
	PA	10	5	18	18		
	Others			9	9		
RVA	Straight PA	10	5	11	11		
	Others			4	4		
LSCA	Straight PA	20	5	5	2	2	1*
	PA	about 10	by hand	3	3		
	Others			3	2	1	
RSCA	Straight PA	20	5	3	1	2	
	Others			2	1		1*
LVA	Straight PA	10	5	1	1		
Total				118	110	6	2*

*…Catheter tip slipped out into the aorta during the injection.

Abbreviations used:

R: right

L: left

CCA: common carotid artery

VA: vertebral artery

SCA: subclavian artery

LPO: left posterior oblique

RPO: right posterior oblique

PA: posteroanterior

E: excellent: IADSA was adequate for the purpose.

G: good: IADSA was helpful, but it incorporated a chance of error.

P: poor: IADSA was not useful.

period, but patients were free to move during observation. Prior to release, patients were advised not to use their right arms until the following morning and were asked to call for assistance immediately, should a problem arise.

The DSA image quality obtained was evaluated and classified as; (1) excellent: adequate for the purpose; (2) good: helpful, but incorporating a chance of error, and (3) poor: not useful[3].

Results

Due to their tortuous brachial arteries, catheterization failed in two men of 63 and 70 years old who had chronic arterial hypertension. There were no complications among the 24 cases.

One-hundred and ten "excellent" images were obtained by means of 118 injections for the 24 patients. Six images were "good", and the remaining 2 images were 'poor' (Table 2). All but one of the images obtained using selective catheterization were "excellent" (Fig. 2—3). However, whenever the catheter tip rebounded and slipped out into the aorta during a contrast medium injection, the image obtained was "poor". In all patients but one for whom bilateral CCA catheterizations were attempted the catheterizations were successfully performed. An aberrant right SCA of one woman prevented catheterization of both her CCAs (Fig. 4). Routinely, examinations of the vertebrobasilar system were attempted using selective catheterization of the right VA, but use of it was difficult. Using a Bentson type guide wire (Cook), success rate of catheterization of the right VA improved. When selective catheterization of the right VA failed, left or right SCA injections were performed, and the resulting image quality was poorer than with selective right VA catheterizations.

This 'right' brachial artery approach prevented selective catheterization of the 'left' VA. However, for

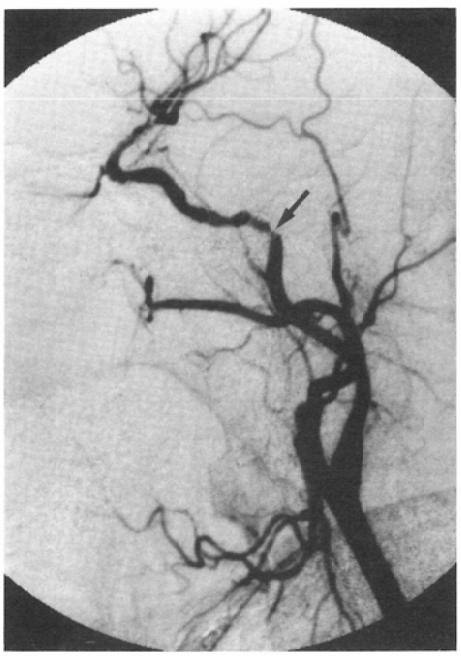

Fig. 2 A 43-year-old man with cerebral infarction. The left CCA was studied using a 10 inch I.I., a 60° RPO projection, a 10 ml injection, and a 5 ml/sec flow rate. Stenosis of the left internal carotid artery is well demonstrated (arrow).

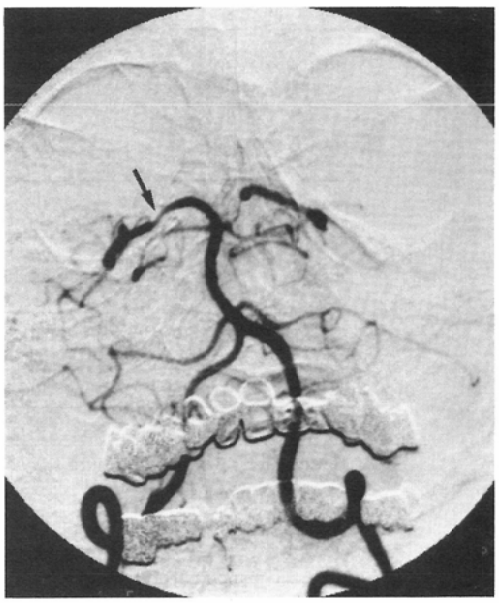

Fig. 3 A 68-year-old man with cerebral infarction. The right VA was studied using a 7 inch I.I., a straight PA projection, a 10 ml injection, and a 5 ml/sec flow rate. Stenosis of the right posterior cerebral artery is shown (arrow). Interpeduncular segment of the left posterior cerebral artery is hypoplastic.

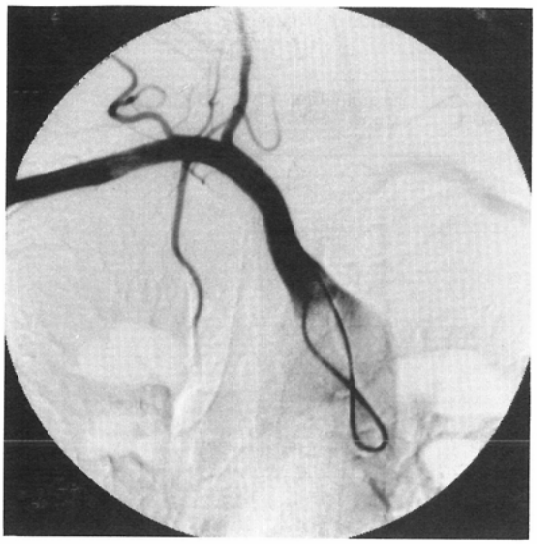

Fig. 4 A 43-year-old woman with suspected cerebral aneurysm. Her aberrant right SCA prevented selective catheterization of her CCAs.

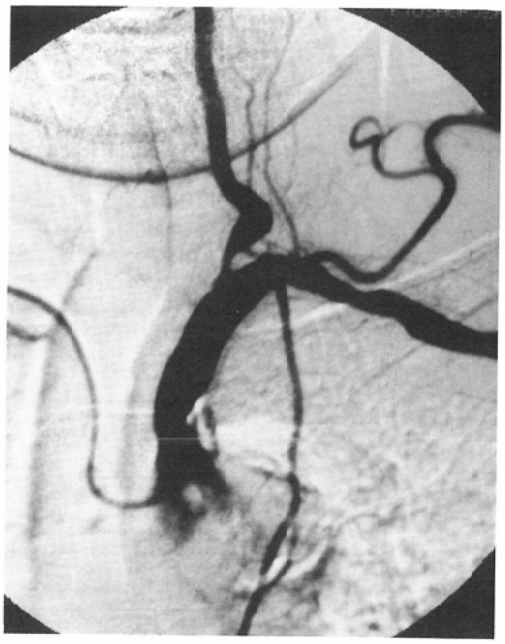

Fig. 5 A 71-year-old woman with cerebral infarction. The left SCA was studied using a 7 inch I.I., a PA projection, and about 10 ml injection by hand. Stenosis of the left VA at its origin is shown.

one patient who had a left VA originating directly from the aorta, selective catheterization was successfully performed. To observe the proximal portion of the left SCA and the origin of the left VA, manual left SCA injections using PA projection were sometimes added. All the resulting images were of "excellent" quality (Fig. 5).

Examination times, from catheter introduction to catheter removal were relatively short. The mean examination time for a three-vessel (bilateral CCAs and right VA) study was 29.4 minutes (Table 3).

Discussion

IADSA with transbrachial arch injections achieve better and higher image quality than that of intravenous DSA[1)-4)]. With both techniques, vessel superimposition and poor vascular opacification obviate definitive studies for an appreciable percentage of patients. From this standpoint, selective IADSA is more suitable for diagnosing cerebrovascular disease. The transfemoral approach is not appropriate for examining outpatients; therefore, transbrachial selective IADSA was recently developed. However, reports of the clinical usefulness of transbrachial selective IADSA are still sparse[6)].

No complications developed in our limited series. However, Gritter et al.[7)] reported a local complication rate of 0.3% among 660 patients who were examined using transbrachial arch injections. Hicks et al.[4)] reported permanent and temporary pulse deficit complications with the 4-F transbrachial technique as 0.55% and 0.83%, respectively, and that complications were more common in women than in men. Therefore, women must be examined with special care. Kuwano et al.[8)], reporting the incidence of spasm at the puncture site, stated that young women who are candidates for transbrachial IADSA should be selected with a great care. Earnest et al.[9)], reporting complications of cerebral angiography, stated that their overall incidence of permanent neurologic deficit was 0.33%, and that relatively old patients, with elevated serum

Table 3 Examination time (from catheter introduction to catheter removal)

Ateries studied	Cases	Injections number/Case	Examination time/Case (min)
RCCA LCCA RVA	5	6	29.4
RCCA LCCA RVA LSCA	4	7	33
RCCA LCCA LSCA	5	4.8	23.6
RCCA LCCA RSCA	3	6	36.7
RCCA LCCA LVA	1	5	29
RCCA LCCA	2	2.5	15.5
RSCA RVA	1	2	17
RCCA	1	2	14
LCCA	1	2	13
RVA	1	2	16

creatinine concentrations, and use of more than one catheter, were significantly associated with severe complications. However, they also reported no statistically significant difference in the incidence of neurologic complications among direct carotid, brachial, and transfemoral techniques. Therefore, the transbrachial approach appears to be as safe as the transfemoral technique, except for local complications.

DSA image quality is related to the doses of contrast medium administered. Since the 4-F modified Simmons type nylon catherer is soft, it easily slips out into the aorta during injections. Therefore, we used a 50% concentration and warmed the contrast media to decrease their viscosity. For bilateral CCAs and right VA injections, a 10 ml injection and a 5 ml/sec flow rate were adequate for our purposes. However, since catheterizations into the right VA were relatively difficult to perform, vertebrobasilar systems were sometimes studied using left or right SCA injections. Due to poor vascular opacification and lack of retrograde flow into the contralateral VA, the quality of the resulting images after SCA injections was less optimal than that of right VA injections. Subsequently, we found that a Bentson type guide wire is very useful during selective catheterizations of the right VA.

We used a 'right' brachial artery approach for all cases due to the limitation of the apparatus. When a different type of DSA unit was available, it might be possible to perform a 'left' brachial artery approach. With use of a 'left' brachial artery approach, selective left VA catheterizations may be easy. However, selective right CCA catheterizations may be difficult using a 'left'brachial artery approach. Therefore, the 'right' brachial artery approach is thought to be more useful than the 'left' brachial artery approach.

Since hypertensive elderly men have arteriosclerotic tortuous brachial arteries, their catheterizations sometimes fail. And aberrant right SCAs are found in 0.4—2.3% of the general population[10]. For these patients, transbrachial IADSA cannot be performed. However, with a right transbrachial approach, selective catheterizations of the brachiocephalic arteries, excluding the right VA, are easily performed. Our

mean examination time for a three-vessel study was 29.4 minutes.

Thus, transbrachial selective IADSA proved to be safe, useful, and relatively easy to perform for the diagnosis of cerebrovascular disease.

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References

1) Becker GJ, Hicks ME, Holden RW, et al: Screening for occlusive vascular disease with intraarterial DSA: Preliminary experience with a high flow 4-F catheter. Radiology 153: 823, 1984
2) McCreary JA, Schellhas KP, Brant-Zawadzki M, et al: Outpatient DSA in cerebrovascular disease using transbrachial arch injections. AJR 145: 941—947, 1985
3) Uchino A, Ohno M: Intra-arterial DSA in cerebrovascular disease using transbrachial arch injection. Nippon Act Radiol 46: 1215—1220, 1986 (Jpn)
4) Hicks ME, Kreipke DL, Becker GJ, et al: Cerebrovascular disease: Evaluation with transbrachial intraarterial digital subtraction angiography using a 4-F catheter. Radiology 161: 545—546, 1986
5) Brant-Zawadzki M. Gould R, Norman D, et al: Digital subtraction cerebral angiography by intraarterial injection: Comparison with conventional angiography. AJR 140: 347—353, 1983
6) Matsunaga N, Hayashi K, Uetani M, et al: Selective cerebral intraarterial digital subtraction angiography by transbrachial approach. Nippon Act Radiol 47: 85—86, 1987 (Jpn)
7) Gritter KJ, Laidlaw WW, Peterson NT: Complications of outpatient transbrachial intraarterial digital subtraction angiography. Radiology 162: 125—127, 1987
8) Kuwano H, Kishikawa T, Kudo S, et al: Assessment of the spasm at the puncture site in the transbrachial digital subtraction angiography (DSA). Nippon Act Radiol 47: 323—325, 1987 (Jpn)
9) Earnest F IV, Forbes G, Sandok BA, et al: Complications of cerebral angiography: Prospective assessment of risk. AJR 142: 247—253, 1984
10) Proto AV, Cuthbert NW, Raider L: Aberrant right subclavian artery: Further observations. ALR 148: 253—257, 1987